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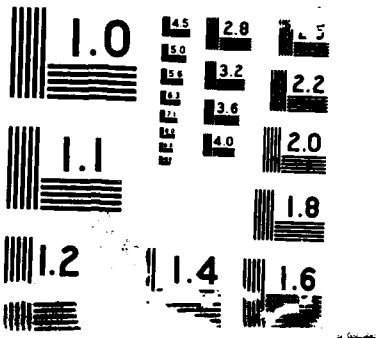
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DECISION AND JUDGMENT: FINAL REPORT

CONTRACT # N00014-84-K-0615 - TVERSKY AND KAHNEMAN

The three-year effort (1984-7) by the two principle investigators is summarized under four major headings: I. the framing of decisions, II. the elicitation of preferences, III. loss aversion, and IV. norm theory. Each of the four topics will be discussed in turn.

I. The framing of decisions

Rational decision theory is characterized by two sets of assumptions: coherence and invariance. The requirements of coherence include transitivity, substitution (or cancellation), and stochastic dominance, which are generally taken as the basic axioms of the theory. The requirements of invariance are typically not stated in an explicit form although they are assumed implicitly in any application of the theory. Description invariance demands that two equivalent descriptions of the same choice problem should lead to the same preference order. The failure of this condition is perhaps the deepest discrepancy between observed preferences and rational decision theory. In an extensive series of experimental demonstrations we have shown that alternative formulations of the same decision problems give rise to systematically different preferences (Tversky & Kahneman, 1986). More specifically, we have shown that a shift in reference point transforms risk aversion into risk seeking. We have also shown that the descriptive validity of the substitution (or independence) axiom of utility theory depends on the framing of the relevant chance events. Finally, we have shown that the common failure to frame concurrent decisions in an aggregate form could lead to violations of stochastic dominance, which is the cornerstone of any rational choice model.

The analysis of framing is important for both theory and practice. Because framing effects and the resulting violations of description invariance are systematic, prevalent and robust, they must be incorporated into any adequate descriptive theory of choice. But since failures of invariance can hardly be justified on normative grounds, they cannot be incorporated into any adequate prescriptive model. Consequently, there is little or no hope for reconciling prescriptive and descriptive theories of choice. This is a far-reaching conclusion, which is at variance with many recent theoretical developments (Tversky & Kahneman, 1986).

Framing effects have considerable practical significance. They have been shown to influence choices involving political prospects and public referenda (Quattrone & Tversky, 1988), responses to (hypothetical) risk of an abnormal child (McNeil, Pauker, & Tversky, 1988), and the effectiveness of health-related activities (Meyerowitz & Chaiken, 1987). From a prescriptive standpoint, the presence of framing effects raise intriguing issues regarding the conduct of decision analysis. If the choice between risk policies or medical treatments depends critically on the manner in which they are formulated, what is the proper way to frame either personal or social decisions? We have advocated the use of comprehensive frames, rather than narrow ones (e.g., in terms of final assets rather than in terms of gains and losses), as well as the use of multiple frames as a form of sensitivity analysis. If different frames, which tend to bias the decision in opposite directions, give rise to the same choice, the preference seems reasonably robust. On the other hand, if different frames elicit different preferences, additional thinking and analyses may be called for (Bell, Raiffa, & Tversky, 1988).

II. The elicitation of preferences

In modern decision theory, the relation of preference appears as a primitive concept that is interpreted through specific empirical procedures such as binary choice, matching or pricing. The standard theory of choice assumes procedure invariance: normatively equivalent procedures for assessing preferences should give rise to the same preference order. Empirical studies of decision and judgment, however, indicate that procedure invariance is not generally satisfied and that observed choice often depends on the method of elicitation. In particular, the ordering of options implied by binary choice does not always coincide with the ordering induced by a matching or pricing procedure. We have investigated this phenomenon both experimentally and theoretically. Perhaps the best known example of an elicitation effect is the preference-reversal phenomenon (see Slovic & Lichtenstein, 1983, for a review). This effect involves a pair of prospects (with comparable expected value), an H bet that offers a high probability of winning a small amount and an L bet that offers a low probability of winning a relatively large amount. The preference-reversal phenomenon refers to the common finding that people tend to prefer H over L, but assign a higher cash equivalent (i.e., a minimum selling price) to L than to H. Although this pattern has been observed in many studies, the data available heretofore were insufficient to determine the causes of this effect, which hindered the empirical interpretation and the theoretical explanation of the phenomenon.

The preference-reversal phenomenon could be attributed either to an intransitivity, or to a failure of procedure invariance. To distinguish between these interpretations, we have developed a more refined experimental design and a new theoretical analysis that provide a

method for diagnosing the determinants of preference reversals (Tversky, Slovic, & Kahneman, 1988). The application of this method to a large data set showed that intransitivity plays a relatively minor role and that the preference reversals are due primarily to the failure of procedure invariance, and more specifically to the overpricing of the L bet. We have interpreted this phenomenon in terms of a compatibility hypothesis according to which input components that are compatible with the output are weighted more heavily than those that are not. Because the pricing response is expressed in monetary units, the payoff is weighted more heavily in pricing than in choice. Further implications of the compatibility hypothesis were confirmed in other studies. In particular, preference reversals were substantially reduced for nonmonetary prizes. Furthermore, we demonstrated preference reversals for choice involving delayed payments (e.g., receiving $2,500 in 30 months) of comparable (discounted) value. As implied by the compatibility hypothesis, people generally select the option that pays sooner but assign a higher (immediate) cash equivalent to the option with the higher payoff (Tversky, Slovic, & Kahneman, 1988).

Preferences can be inferred from direct choice between options or from a matching procedure in which the decision maker adjusts one option to match another. Studies of preferences between two-dimensional options show that the more prominent dimension looms larger in choice than in matching (Tversky, Sattath, & Slovic, 1988). Thus, choice is more lexicographic than matching. To account for such effects, we developed a hierarchy of models in which the tradeoff between attributes is contingent on the nature of the response. The simplest theory of this type, called the contingent weighting model, has been applied to the analysis of various elicitation effects, including the choice-matching discrepancy and the preference-reversal

phenomenon. The presence of systematic elicitation effects, which violate procedure invariance, underscores the discrepancy between the normative and the descriptive approaches to choice and raise both conceptual and practical questions concerning the nature, the meaning and the assessment of preference.

III. Loss Aversion

Our analysis of risky choice (Kahneman & Tversky, 1984) assumes that the outcomes of decisions are naturally treated as gains and losses in relation to some neutral reference level. We assumed that prospects are evaluated by invoking a value function, defined on gains and losses. The proposed value function is generally S-shaped, concave in the domain of gains and convex in the domain of losses. Furthermore, the function is steeper in the negative than in the positive domain ($v'(-x) < v'(x)$, for all $x>0$). The latter property, which we label loss aversion is the focus of the present analysis of riskless choice, which is summarized in the following five sections.

1) Measuring loss aversion by acceptable gambles.

We have used risky choices to estimate the relative steepness of the value function in the positive and negative domains, for small gains and losses. To meet the standard objections of economists, the decisions involve a substantial probability of a real payoff. The participants are first asked to consider a mixed prospect (.25 to lose $5, .50 to win nothing, .25 to win $20), and to determine whether they would accept that prospect with real outcomes. All participants normally accept the original prospect. They are then asked to consider an alternative prospect in

which the potential gain was left indeterminate: .25 to lose \$15, .50 to win nothing, .25 to win \$X), and to indicate the value of X that would make the two prospects equally attractive. A Vickrey (i.e., a second price) auction is conducted to encourage each participant to reveal the value of X that makes him/her indifferent between the two prospects. According to prospect theory, the value of the two prospects are given respectively by

$$\pi(.25)[v(-5) + v(20)] \text{ and } \pi(.25)[v(-15) + v(X)]$$

When the two prospects are adjusted to indifference, therefore, we obtain

$$v(X) - v(20) = v(-5) - v(-15).$$

In a number of replications, the median value of X was \$60: thus, an increase from \$20 to \$60 in the size of the possible gain is required to compensate for an increase from \$5 to \$15 in the size of a possible loss. A loss aversion factor of 4 is suggested by these results. Other evidence provides estimates in the range of 2-4.

For purposes of comparison, a similar procedure was followed to find a value Y that makes the prospect (.25 to win \$5 and .25 to win Y) as attractive as the prospect (.25 to win \$15 and .25 to win \$40). It may be noted that the second problem is the same as the first, translated upward by \$20. The median value of Y in several replications has been \$52. Note that in this case the difference between gains of \$5 and \$15 is matched by a difference between gains of \$40 and \$52 -- a qualitatively different pattern than is observed when gains are compared to losses.

The results provide evidence for a substantial difference in slope between the positive and the negative segments of v, far too extreme to be accommodated by an income effect or by any reasonable utility function for wealth.

2) Disadvantages loom larger than advantages.

The following proposition represents the most direct extension of loss aversion to the case of riskless choice: a given difference between two options on an attribute of value has a greater impact if it is coded as a difference between negative outcomes than if it is coded as a difference between positive outcomes. In other words, a difference in the magnitude of a disadvantage looms larger than a corresponding difference between advantages. The relevant experimental manipulation involves changes in the position of the neutral reference point, to induce the appropriate coding of the options.

A procedure that we have used to study this hypothesis is illustrated below.

> Imagine that you have been holding a part-time job, which is now ending so that you must look for another. You consider two possibilities. They are like your present job in most respects except for pay, the amount of social contact and the convenience of commuting to and from work. You have made up the following table:

	Pay	Social Contact	Commuting
Present job	\$7/hr.	isolated for long stretches	20 min.
Job X	\$6.50/hr.	limited contact with others	10 min.
Job Y	\$6.50/hr.	very pleasant interaction	35 min.

Which job would you choose?

___Job X ___Job Y

Other students in the class that encountered the previous problem answered another version, which offered exactly the same descriptions of jobs X and Y were given, but included a different description of the current job, as follows:

Present job $7/hr. moderately sociable 45 min.

The format has been chosen to encourage the encoding of the various attributes of Jobs X and Y as advantages or disadvantages, with the corresponding attributes of the current job providing the reference values. In the real world, of course, the processes that generate adaptation levels are likely to produce the same manner of coding.

The hypothesis of loss aversion entails that an attribute of an option will have a greater impact on its attractiveness when it is coded as a disadvantage than as an advantage. The long commute associated with Job Y is therefore expected to have more impact in the first formulation than in the second. The difference between the two jobs in opportunities for social contact should have greater impact in the second version than in the first. Indeed, Job X was chosen much more often in the first formulation than in the second. Several other studies in the same general design yielded similar results.

3) Experimental demonstrations of the endowment effect.

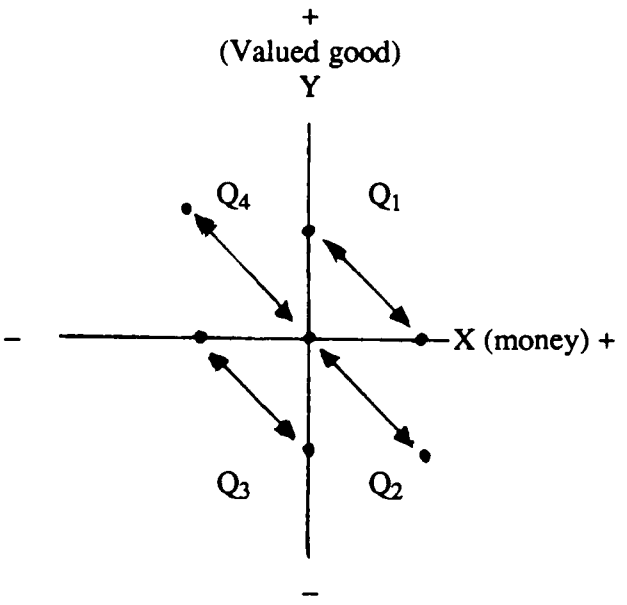
The value of a good to an individual who does not possess that good is commonly measured by the highest price that the individual would pay to acquire the good. The value of a good to an individual who owns it is similarly measured by the lowest price that would induce the owner to give up the good. An immediate implication of loss aversion is that the value of a good will be greater to the potential seller than to the potential buyer because the same good is evaluated as a loss by the one and as a gain by the other.

A series of experiments using the techniques of experimental economics have demonstrated this effect (Knetsch, Thaler, & Kahneman, 1988). The experiments used a random allocation design in which half of the students in a class are given a good (e.g., a decorated mug worth about $5 at the campus bookstore). A market is then set up, in which the newly endowed owners of a mug have an opportunity to sell their mug to the students who were not endowed. The technique provides for a comparison of the median selling price of buyers and sellers, under conditions that provide all actors with a strong inducement to reveal their true value. A consistent finding is that the selling price for goods such as mugs, pens, fancy binoculars is 2-3 times higher than the buying price.

Another demonstration of the endowment effect was carried out by comparing the prices set for a mug or a pen by sellers who were actually given the good and by choosers who were offered a choice between the same good and a sum of money. In three separate experiments the value assigned by sellers was approximately twice as high as the value assigned by choosers. This result is predicted by loss aversion: the choosers presumably evaluate the mug as a gain, whereas the sellers who have physical control of a mug evaluate it as a loss.

4) The quadrant structure.

A more general treatment of the type of riskless transactions discussed in the previous section is given in the figure below, which presents four elementary types of decision problems involving two attributes X and Y, each coded as a gain or as a loss. The tips of the arrows mark options between which the decision maker must choose. The current position of the decision maker is at the origin. Because many or the problems we have studied involve money as one of the attributes, we adopt the convention of labeling the X axis 'money' and the Y-axis 'valued good'. Note that the decisions in Q1 and Q3 require a choice between two new positions. The decisions in Q2 and Q4 concern the acceptability of a transaction in which a valued good may be sold or bought, with the retention of the status quo as the alternative option.



The hypothesis of loss aversion has several implications for the relative preferences of attributes X and Y in the decision. Specifically, the hypothesis that losses loom larger than objectively corresponding gains suggest that money will be more important in buying than in

positive choice, and more important in negative choice than in selling. Similarly, the good will be more important when it may be given up (Q2 and Q3) than when it may be acquired (Q1 and Q4).

Many choices between options (objectively described by end-values in two attributes) can be represented in any of the four quadrants, depending on the location of the reference point. For example, consider Person A who earns $33,000 and faces a 0.5% annual risk of work injury. Would Person A accept an increase to 1% annual risk, accompanied by a raise of $1,000? Now consider Person B, who currently earns $34,000 and lives with a 1% annual risk. Would Person B accept a reduction of $1,000 in income, accompanied by a reduction of the risk to 0.5%? Note that the two individuals face the same choice between two combinations of risk and income. However, this choice is framed as selling safety for Person A, and as buying safety for Person B.

Survey data collected in telephone interviews of residents of Toronto confirm that people make different choices in the two situations. People are generally unwilling to accept increases in the risks that they face, even when they are not very willing to pay to reduce these risks. Reluctance to trade was confirmed in survey studies (with and without framing manipulations) with several other pairs of attributes, including income vs. leisure, and current contributions to savings vs. future benefits.

5) Loss aversion in judgments of fairness.

The notion of loss aversion played a central role in the interpretation of an extensive study of intuitions about the fairness of economic transactions (Kahneman, Knetsch & Thaler, 1986a,b). The results could be readily interpreted on the assumption that the setting of prices or

wages is evaluated in comparison to a reference transaction, and that the gains and losses to the agent and to those affected by his or her decision are critical to judged fairness. Thus, different rules apply to the sharing of gains (which is not required), to the sharing of losses (which is not required either), and to actions that impose a loss on others but achieve a gain for the agent (usually unacceptable). Actions that are taken to prevent a loss to oneself are acceptable whereas actions that have the same consequences for others but bring a gain to the agent are rejected as unfair. Another manifestation of the differential treatment of gains and losses in this context is the contrast between the cancellation of bonuses and discounts and objectively equivalent prices increases or wage cuts. Cancelling bonuses and discounts is more acceptable, evidently because these actions are perceived as eliminating a gain, rather than as imposing a loss. The hypothesis that the rules of fairness affect economic behavior was shown to explain a number of economic phenomena.

Maynard Keynes introduced the notion of 'money illusion' to explain the relatively weak resistance of labor to real wage losses in inflation. The surveys of fairness provided some evidence of this phenomenon, and linked it to loss aversion. In particular, 62% of respondents thought it was unfair for a company that makes a small profit to cut its workers' wage by 5% during a recession without inflation. However, only 22% thought it unfair for a company to raise its workers' wage by 7% when inflation is 12%. The fact that the nominal wage increases apparently masks the real wage loss.

IV. Norm Theory

One of the developments in the study of judgment during the current grant period was the formulation of norm theory (Kahneman & Miller, 1986). The central idea of this theory is that a memory probe can cause multiple representations of objects or events to be evoked, that these representations can be aggregated, and that the aggregates can be 'read' and used for various judgment tasks. Thus, a category label evokes multiple exemplars, and the experience of a specific event evokes memories or counterfactual constructions of what it could have been. The statistics of these evoked representations define norms for various attributes, such as the size of dogs (evoked by the phrase 'large dog') or the clothes that John usually wears (evoked when John shows up).

Norm theory proposed (i) that the norms evoked by experiences of objects and events provide the context in which these experiences are interpreted, and (ii) that the norms evoked by category labels serve as ad hoc representations of our knowledge of things and events. The dependent measures for which the theory has implications include assessments of normality or surprise value, judgments that relate an observation to a standard of reference, the generation of counterfactuals, affective responses to highly available counterfactuals (as in regret, shame or frustration), and various aspects of causal thinking.

The information contained in norms is assumed to be accessible to various judgmental operations, both involuntary and deliberate. In particular, the normality or surprise value of any attended stimulus is evaluated as a by-product of routine cognitive processing of events. Surprise is registered if some features of a stimulus are abnormal in the set of elements which that

stimulus has evoked. In addition, it is proposed that the relative position of an attribute value in a norm can be evaluated -- yielding the internal representation of a percentile score.

The principal independent variables of norm theory are the factors that control the selective activation of some representations by an event or by a category label. The main process assumption is that a stimulus evokes representations of others that resemble it. The analysis of stimulus norms assumes that the alternatives evoked by an event are constrained to share some of its features, but are free to vary in other features. We label the former features (or attributes) immutable, the latter mutable.

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